Claims

[c1] What is claimed is:

1.A method of forming multiple oxide layers with different thicknesses on a semiconductor substrate by performing a linear nitrogen doping process and an oxidation process, the semiconductor substrate comprising a silicon surface, the silicon surface comprising a first region and a second region, the method comprising:

forming a sacrificial oxide layer on the silicon surface to cover both the first region and the second region;

forming a mask layer on the surface of the sacrificial oxide layer;

defining and patterning the mask layer to form a first opening having a first predetermined surface area, and a second opening having a second predetermined surface area, the first opening and the second opening formed in portions of the mask layer within the first region and portions of the mask layer within the second region, respectively, to respectively expose portions of the sacrificial oxide layer having a surface area equal to the first predetermined surface area, and portions of the sacrificial oxide layer having a surface area equal to the second predetermined surface area;

performing a linear nitrogen doping process to simultaneously implant nitrogen ions with a first predetermined concentration and nitrogen ions with a second predetermined concentration into the first region and the second region, respectively, through the first opening and the second opening, respectively, wherein a ratio of the first predetermined surface area to the second predetermined surface area is defined as a constant k;

removing the mask layer;

removing the sacrificial oxide layer; and

performing an oxidation process to form a first silicon oxide layer having a first predetermined thickness and a second silicon oxide layer having a second predetermined thickness in the first and second regions, respectively.

[c2] 2.The method of claim 1 wherein the first predetermined surface area is greater than the second predetermined surface area, the first predetermined concentration being greater than the second predetermined concentration, and

the first predetermined thickness is less than the second predetermined thickness.

[c3] 3.The method of claim 1 wherein the sacrificial oxide layer has a thickness ranging from 150 to 250 angstroms.

[c4] 4.The method of claim 1 wherein the mask layer comprises a photoresist layer.

[c5] 5.The method of claim 1 wherein the semiconductor substrate comprises a silicon substrate.

[c6] 6.The method of claim 1 wherein the semiconductor substrate comprises a silicon-on-insulator (SOI) substrate.

[c7] 7.The method of claim 1 wherein an implantation dosage of the nitrogen ions in the linear nitrogen doping process is N_2^+ ranging from 1×10^{14} to 1×10^{16} cm^{-2} with an implantation energy of approximately 30Kev.

[c8] 8.A method of forming multiple oxide layers with different thicknesses comprising:

providing a semiconductor substrate comprising a silicon surface with a first region and a second region;

forming a sacrificial oxide layer on the silicon surface to cover both the first region and the second region;

forming a mask layer comprising a first opening with a first predetermined surface area in portions of the mask layer within the first region, and multiple second openings, each second opening having a second predetermined surface area, in portions of the mask layer within the second region, on the surface of the sacrificial oxide layer to respectively expose portions of the sacrificial oxide layer having a surface area equal to the first predetermined surface area, and portions of the sacrificial oxide layer, each having a surface area equal to the second predetermined surface area;

performing a linear nitrogen doping process to simultaneously implant nitrogen ions with a first predetermined concentration and nitrogen ions with a second predetermined concentration into the first region and the second region, respectively, through the first opening and the second opening, respectively;

removing the mask layer;
removing the sacrificial oxide layer; and
performing an oxidation process to form a first silicon oxide layer having a first predetermined thickness, and a second silicon oxide layer having a second predetermined thickness, in the first and second regions, respectively.

[c9] 9.The method of claim 8 wherein the first predetermined surface area is greater than the second predetermined surface area, the first predetermined concentration being greater than the second predetermined concentration, and the first predetermined thickness is less than the second predetermined thickness.

[c10] 10.The method of claim 8 wherein a ratio of the first predetermined surface area to the second predetermined surface area is defined as a constant k.

[c11] 11.The method of claim 8 wherein the sacrificial oxide layer has a thickness ranging from 150 to 250 angstroms.

[c12] 12.The method of claim 8 wherein the semiconductor substrate comprises an SOI substrate.

[c13] 13.The method of claim 8 wherein the mask layer comprises a photoresist layer.

[c14] 14.The method of claim 8 wherein the implantation dosage of the nitrogen ions in the linear nitrogen doping process is N_2^+ ranging from 1×10^{14} to 1×10^{16} cm^{-2} with an implantation energy of approximately 30Kev.